

EFFECT OF IMPLEMENT ASSISTED SOFT TISSUE MOBILIZATION ON ILIOTIBIAL  
BAND TIGHTNESS

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## DEDICATION

To my family- who have always instilled a passion for learning and who gifted me with the talent to succeed in life. Thank you for always listening to my struggles and triumphs and always supporting me. Without you none of this would be possible- thank you for believing in me.

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## EFFECT OF IMPLEMENT ASSISTED SOFT TISSUE MOBILIZATION ON ILIOTIBIAL BAND TIGHTNESS

The purpose of this investigation was: 1) to determine if implement assisted soft tissue mobilization techniques influence iliotibial band flexibility, and 2) to determine if differences exist between methods of implement assisted soft tissue mobilization, specifically Graston Technique® and Gua Sha technique.

Sixty healthy, physically active subjects from a large midwestern university volunteered to participate in this study. Subjects were without a history of iliotibial band (ITB) injury within the past six months. Additionally, subjects were screened for hyper ITB mobility prior to beginning the study. Only those subjects with baseline range of motion measurements of 26 degrees or less of hip adduction were included in this study. Subjects were randomly assigned to three different treatment groups: Graston Technique®, Gua Sha, and a control group. Each subject's hip adduction (ITB flexibility) was measured using a digital inclinometer. Three trials of hip adduction were completed after each treatment. Subjects participated in 4 days of treatment, with 48-72 hours between treatments. Repeated measures analysis of variance was used to analyze the data for each treatment group. A priori alpha was set at <0.05.

Results of the statistical analysis revealed a significant group by test interaction. Follow up post hoc testing revealed subjects in the Graston Technique® group had a significant increase in hip range of motion on each test day as compared to the baseline measure. The Gua Sha group had a significant increase in hip adduction range of motion on days 2, 3, and 4 as compared to the baseline range of motion. There was no change in the control group range of

motion. Additionally a significant difference was identified between groups. Post hoc testing identified a significant difference between the Graston Technique® group and the control group.

Both the Graston Technique® and Gua Sha methods of soft tissue mobilization significantly increased hip adduction range of motion compared to baseline values. Clinicians who opt to use methods of soft tissue mobilization in relieving tightness can use implement assisted soft tissue mobilization to ease the stress on their hands. Graston Technique® and Gua Sha are two such methods, and results of this study indicate that both are effective in increasing hip adduction range of motion. The Graston Technique®, however, demonstrated the greatest improvement in range of motion over time.

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## INTRODUCTION

Human fascia is a complex connective tissue system that encompasses all aspects of the body and includes multiple subcategories of connective tissues.<sup>1</sup> Deep fascia consists of dense connective tissue, which is composed mostly of collagen fibers.<sup>2-7</sup> Collagen fibers provide fascia with tensile strength and allows the fascia to act, in some cases, as a support structure as well as a mechanical aid to muscle contractions.<sup>4</sup> Soft tissue adhesions are abnormal tissues resulting from microscopic or macroscopic trauma that bind or restrict normal connective tissue movement. Soft tissue adhesions are theorized to cause limited range of motion of a joint, generate pain, and predispose an individual to related pathologies.<sup>8</sup> Soft tissue mobilization is a therapeutic intervention beneficial in relieving fascial adhesions.<sup>9-11</sup>

One common anatomical site of soft tissue adhesions is the iliotibial band, which contributes to pathologies such as iliotibial band syndrome and patellofemoral pain syndrome.<sup>9-11</sup> The iliotibial band (ITB) is a thickening of the fascia lata, a layer of deep fascia of the thigh. The ITB arises from the anterior portion of the outer lip of the iliac crest; from the outer surface of the anterior superior iliac spine, the gluteus maximus, and gluteus minimus; inserting distally on the thigh through an intramuscular septum as well as on the tibia at Gerdy's tubercle.<sup>2, 4-6</sup> As the tendinous attachment of the tensor fasciae latae muscle, a primary hip abductor, the ITB assists muscle in accomplishing the movement of hip abduction. Contracture and tightness of the ITB frequently occurs with persistent hip abduction or postural positioning.<sup>3, 12</sup>

Both iliotibial band syndrome (ITBS) and patellofemoral pain syndrome (PFPS) have been attributed to causing anterior knee pain in athletes.<sup>8, 13-19</sup> Conservative treatments for ITBS and PFPS include a variety of interventions: stretching, strengthening exercises, activity modification, cyrotherapy, trigger point therapy and other manual therapy techniques.<sup>8, 13-19</sup> Soft



tissue mobilization is one such manual therapy technique that may be used to relieve myofascial adhesions and associated pain.<sup>8</sup> In an effort to relieve clinician fatigue with this predominantly manual technique, and provide the hands with greater mechanical advantage, instrument assisted methods of soft tissue mobilization have been created.<sup>20</sup>

Soft tissue mobilization (STM) is a generic term for various techniques of manual and implemented manipulation of soft tissue structures. Some of the manual STM techniques include massage, muscle energy, active release technique (ART<sup>®</sup>), and myofascial release. Implement assisted STM (ISTM or IASTM) techniques include any STM procedures with the assistance of an instrument, i.e. Graston Technique<sup>®</sup>, or the traditional Eastern medicine practice of Gua Sha. Graston Technique<sup>®</sup> is a soft tissue mobilization technique utilizing patented stainless steel instruments to assist the clinician in identifying and treating soft tissue adhesions, followed with specific stretching and strengthening exercises of targeted tissues.<sup>21-34</sup> Graston Technique<sup>®</sup> treatments have been reported to aid in the proliferation of fibroblasts,<sup>23, 25</sup> decrease pain,<sup>22, 27-29, 32, 34</sup> increase functional activities,<sup>22, 27-29, 32, 34</sup> increase range of motion<sup>22, 27-29, 32, 34</sup> and decrease fascial restrictions.<sup>20-34</sup> Early investigations of Graston Technique<sup>®</sup> have shown promise in relieving symptoms of many soft tissue pathologies. Case studies have reported that Graston Technique<sup>®</sup> relieves symptoms of carpal tunnel syndrome,<sup>22, 34</sup> lateral epicondylitis,<sup>27</sup> Achilles tendonitis<sup>28</sup> and plantar fasciitis.<sup>28</sup> Graston Technique<sup>®</sup> has also been reported to increase range of motion, as evidenced in case report of a post-surgical ankle<sup>32</sup> as well as in a case report of lumbar compartment syndrome.<sup>29</sup>

Gua Sha is another method of instrument assisted soft tissue mobilization that utilizes any smooth edged instrument, such as a jar lid, or specially created Gua Sha tools.<sup>35, 36</sup> Traditional Gua Sha tools are made of bone or horn, but can also be made of high density plastic. In Eastern

medicine practice, Gua Sha consists of repeated, unidirectional, pressured stroking with a smooth edge over an area until sha blemishes arise.<sup>35,36</sup> Sha blemishes are indicated by the appearance of petechiae during and after treatment. Gua Sha has been shown to increase surface microcirculation, as a result of damage to the capillary beds.<sup>36</sup> No research has been published in Western, English language journals on the use of Gua Sha to reduce soft tissue adhesions.

Clinically several methods of soft tissue mobilization have been utilized, including Graston Technique® and Gua Sha. Limited randomized clinical trials exist on either method, and no research currently exists comparing these methods of implement assisted soft tissue mobilization. Therefore, the purpose of this investigation is: 1) to determine if implement assisted soft tissue mobilization techniques influence iliotibial band flexibility, and 2) to determine if differences exist between methods of implement assisted soft tissue mobilization, specifically Graston Technique® and Gua Sha technique.

## METHODS

### **Subjects**

Sixty healthy subjects from a large midwestern university volunteered to participate in this study. Participants were recruited from kinesiology classes at the university. Participants were selected on the basis of being physically active. Physically active was defined as engaging in aerobic exercise of any intensity for at least thirty minutes, a minimum of three times per week. Participants were without a history of ITB injury within the past six months. Participants had no current or recent history (past 6 months) of iliotibial band syndrome or patellofemoral pain syndrome.

In addition, participants were screened for hyper ITB mobility prior to beginning the study. Standard range of motion is 10-26 degrees for hip adduction.<sup>37</sup> Only those participants

with baseline range of motion measurements of 26 degrees or less of hip adduction were included in this study, as those without tightness were less likely to see changes in range of motion. Participants with ITB tightness were chosen for this study in order to see a more clinically relevant population and study outcome. Basic demographic and baseline range of motion data for all subjects is shown in Table 1. Before participating in the study, all participants read and signed an informed consent form approved by the University's Institutional Review Board for the Protection of Human Subjects, which also approved the study.

### **Instrumentation**

The Acumar Digital Inclinometer and Acumar IR Wireless Computer Interface (Lafayette Instrument Company, Lafayette, Indiana) was used to measure the subject's passive range of hip adduction during the modified Ober's test. (Figure 1) This device has been established in previous research as a reliable instrument to evaluate iliotibial band length and hip adduction.<sup>38</sup> The stainless steel Graston Technique<sup>®</sup> instruments, GT-1 GT-4 and GT-3, (TherapyCare, Indianapolis, Indiana) were used to treat the Graston Technique<sup>®</sup> group (Figure 2). A natural, polished horn Gua Sha tool (Horse Holistics, Davidson, North Carolina) was used to treat the Gua Sha group (Figure 3).

### **Procedures**

Prior to beginning this investigation all subjects were pseudo-randomly assigned to either the Graston Technique<sup>®</sup>, Gua Sha, or control group. Each group corresponded to the treatment subjects received. The left leg was arbitrarily chosen for treatment on all participants. Baseline measures were collected on day 1 of testing before beginning treatment; a modified Ober's test was conducted post-treatment to obtain measures of hip adduction. All subjects participated in four days of testing, with 48 to 72 hours between testing sessions.

## Testing

Before testing the inclinometer was zeroed on a known level surface. Subjects were positioned and secured on their right side with the hip and knee of the right leg bent at 45 degrees and 90 degrees, respectively, to provide stabilization. The examiner's hand assisted in stabilizing the pelvis against the table and against anterior/posterior motion. Fastened straps were used over the subject's shoulder, back and hips to provide extra stabilization and to prevent hip movement during the test. (Figure 4) The examiner used their left hand to passively flex, abduct and then extend the left hip. The examiner asked the subject to remain relaxed while the test was being performed.

As the left leg was passively adducted the examiner provided support at the medial joint line of the left knee. The end position was when hip adduction stopped or movement was felt at the pelvis.<sup>39</sup> Once the end position was reached a measure of hip adduction (degrees) was digitally saved in the inclinometer. Three trials of the modified Ober's test were completed and data were directly sent to the computer using a wireless infrared transmitter.

## Treatment

Subject positioning was identical for all three of the treatment groups. Each subject laid on their right side with hip and knee bent to provide stabilization at approximately 45 degrees and 90 degrees, respectively. A specific management plan was established in the event that complications occurred during the study. If a participant returned with significant (forty percent of treatment area or more) or painful ecchymosis of the treatment area, an additional 24 hours was added between testing days and the subsequent treatment was given at a lighter pressure.<sup>20</sup> If the subject still had significant or painful ecchymosis with the additional day, the subject's participation in the study was terminated. (Figure 5)

### Graston Technique®

Subjects rode a stationary bicycle at 80 RPM for 5 minutes to actively warm up the tissues in the leg. Emollient was applied to the leg from just below the knee to the area of the greater trochanter. The GT-1 instrument was used to assess the lateral leg in three segments: over the ITB, just anterior to the ITB and posterior to it. GT-4, a convex treatment instrument, was then used to apply sweeping and fanning strokes to the tissues in the same areas. The GT-3 instrument was then used to treat the insertion of the ITB at Gerdy's tubercle and the lateral patellofemoral structures with the knee extended. Framing, a specific technique to address large myofascial boney interfaces, was performed with the GT-3 proximally around the greater trochanter. The tensor fascia latae contractile component was also treated with the knee extended using the GT-3 in a cross fiber manner. Subsequently, two sets of stretching for 30 seconds, with a 30 second rest between each stretch, were performed. The subject lay in the testing position and the examiner stretched the IT band by placing the leg in hip adduction, with 90 degrees of knee flexion, until a stretch was felt. Two low load exercises were then performed by the subject, each exercise performed for 2 sets of 20 repetitions with a 30 second rest between each set or until early fatigue was observed. The first exercise performed was a hip external rotation motion or clamshell; the subject laid with feet aligned with hip, feet together then abducted and externally rotated the left leg. The second exercise performed was abduction at 15 degrees of hip flexion and external rotation. At the conclusion of the treatment subjects had an ice bag secured to the treatment area and were instructed to leave it on for 20 minutes as in accordance with the treatment protocol.

### Gua Sha

Gua Sha treatment consisted of repeated uni-directional stroking of the treatment area with a Gua Sha tool. Stroke lines were marked off in 6-inch increments over the ITB using a permanent marker and emollient was then applied to the skin before treatment with the Gua Sha tool. Unilateral, downward stroking of the skin with the tool at approximately a 45-degree angle was done over the ITB until each stroke line of the treatment area had been given 30 strokes with the tool.

### Control Group

Subjects assigned to the control group were placed in the treatment position for 8 minutes and received a sham microcurrent treatment. Two electrode pads were placed on the subject's ITB. The first pad was placed on the insertion of the ITB at the greater trochanter and the second pad distally on the insertion at Gerdy's tubercle. Electrodes were plugged into machine, the machine was turned on, but intensity was not increased. Subjects received instructions to lie still while the treatment was occurring and that they should not expect to feel anything during treatment.

### Statistical Analysis

Means and standard deviations of hip adduction were calculated for the three trials of the modified Ober's test on all test days. All data were imported into PASW Statistics (version 18 for Windows, SPSS Inc, Chicago, IL). Hip adduction measurements were examined with a repeated measures analysis of variance (RMANOVA). The first RMANOVA had 1 within-subjects factor (day at 5 levels [baseline, posttreatment day 1, posttreatment day 2, posttreatment day 3, posttreatment day 4]) and 1 between-subjects factor (group at 3 levels [Graston, Gua Sha, control]). A second RMANOVA examined differences in the Graston Technique® group with 1 within-subjects factors (time at 3 levels [pre GT strokes, post GT strokes, post full protocol]).

Bonferroni post-hoc testing was conducted on any significant findings. For all calculations the alpha level was set a priori at  $P < .05$ .

## RESULTS

Interpretation of the RMANOVA identified a significant day by group interaction ( $F_{8,228} = 2.12$ ,  $p = 0.03$ , Figure 5). Follow up testing showed a significant difference in the Graston Technique® group between baseline range of motion and post-treatment range of motion on days 1, 2, 3 and 4. Additionally, significant difference was found in the Gua Sha group range of motion between baseline values and range of motion values post-treatment on days 2, 3, and 4. No significant differences in range of motion were identified between the test days of the control group. Means and standard deviations of range of motion as measured in degrees for each group are located in Table 2. A significant difference was also identified between the groups ( $F_{2,57} = 3.58$ ,  $p = 0.03$ ). Post hoc analysis revealed a significant difference between the Graston Technique® group ( $24.64^\circ \pm 0.87^\circ$ ) and the control group ( $21.41^\circ \pm 0.87^\circ$ ). No significant difference was found between the Gua Sha ( $22.47^\circ \pm 0.87^\circ$ ) and Graston Technique® group or the Gua Sha and Control group.

The secondary analysis of the Graston Technique® group identified a significant main effect for time ( $F_{2,38} = 15.99$ ,  $p < 0.01$ ). Post hoc testing showed a significant increase from pre GT strokes range of motion ( $23.07^\circ \pm 1.23^\circ$ ) to the post GT strokes range of motion ( $25.01^\circ \pm 1.43^\circ$ ). (Figure 6) A significant increase was also found between the pre GT strokes range of motion measure and after the full Graston Technique® protocol ( $25.75^\circ \pm 1.33^\circ$ ). No significant difference existed between the range of motion after the Graston Technique® strokes and range of motion after the full Graston Technique® protocol.

## DISCUSSION

The primary finding is that the implement assisted soft tissue mobilization techniques examined in this study increased hip adduction flexibility when compared to baseline range of motion measures. When examining the change in range of motion over the four test days, the Graston Technique® group showed a 25% improvement in overall range of motion, from baseline to day 4. The Graston Technique® group increased range of motion on each test day compared to baseline, indicating an immediate and progressive change in flexibility. The Graston Technique® group saw the greatest increase in range of motion from baseline to post-treatment on day 1, and then again from day 3 post-treatment to day 4 post-treatment. The Gua Sha group improved range of motion 15% from baseline to day 4 post-treatment. On days 2, 3, and 4 the Gua Sha group exhibited increased range of motion, but not as dramatically as the Graston Technique® group. The control group did not demonstrate significant change, a result that was expected from the sham treatment.

We hypothesized that there would be a difference between the Graston Technique® group and the Gua Sha group. Post hoc analysis revealed no significant differences between the Graston Technique® group and the Gua Sha group. However, the participants in the Graston Technique® group had significantly more range of motion than participants in the control group following treatment.

#### Graston Technique® Group

The Graston Technique® directs clinicians to use a holistically developed protocol for treating soft tissue pathologies. The protocol includes a warm-up, the Graston Technique® strokes, stretching, resistance exercises, and post-treatment cryotherapy.<sup>20</sup> The protocol is individualized and should be changed to meet patient needs and clinician goals. Subsequently, we wanted to evaluate if an impact on range of motion existed if subjects received only the



Graston Technique® strokes, or if the full protocol was needed to produce significant changes in hip adduction range of motion. Previous research has not established the need for the full protocol and case reports are ambiguous on whether the full protocol was used.<sup>21, 22, 24, 28-30, 34</sup> Our results indicated that immediately after employing the Graston Technique® strokes alone an almost 8% increase in range of motion was identified. However, the addition of the stretching and exercise activities only provided a minimal, 3%, increase in range of motion. Clinicians who use the Graston Technique® as a treatment for tight iliotibial bands can use these findings as evidence in clinical decisions to use the full Graston Technique® protocol or to use the Graston Technique® strokes in isolation.

Bruising or ecchymosis can be a common treatment side effect of Graston Technique® strokes if the clinician's objective is creating microtrauma to the collagen fibers to re-enter the healing cascade. As per protocol, treatment is administered to patient tolerance, but at a level that will still result in fiber changes. Five subjects in the Graston Technique® group had significant bruising during the testing period and received properly modified treatment (3 subjects after day one of treatment and 2 subjects after day 2 of treatment). Only 1 subject's participation was terminated in response to the examiner's assessment of excessive bruising. While only 5 subjects had significant bruising, meaning 40 percent or more of the treatment area had painful ecchymosis, many subjects had minimal or pain free ecchymosis as a result of the treatment. Research has not examined the roll that the subsequent ecchymosis has on changes in range of motion. It is unknown why certain subjects bruise more than others. Subjects whom had significant bruising may have had more adhesions which resulted in greater microtrauma with application of the Graston Technique® strokes.

#### Gua Sha Group

Over time the Gua Sha group demonstrated a 15% increase in range of motion compared to the baseline measure. Currently no set protocol for Gua Sha has been established in relation to increasing flexibility. Gua Sha is a traditional Eastern medicine practice, and as such the technique is taught informally. Literature concerning Gua Sha explains two different methods for administering the treatment.<sup>35, 36, 42, 43</sup> Each treatment uses stroking of the tool over a set stroke line, in approximately 6-inch increments, over a total treatment area. The first method uses a set number of strokes over each stroke line, repeated at each stroke line area until the entire treatment area is covered.<sup>35, 36, 42</sup> This protocol was used in this study to maintain uniformity; additionally the primary author was trained to utilize this method of Gua Sha application. The second, more aggressive method does not suggest a set number of strokes, but that the clinician administers strokes over each stroke line until a sha blemish occurs. This approach is repeated over each stroke line area until the entire treatment area has been addressed and no more sha blemish could appear.<sup>35, 36, 42, 43</sup>

Gua Sha is theorized to increase blood flow through the presence of sha, or excess heat, to an area that shows stasis of sha.<sup>35, 36, 43, 44</sup> The majority of subjects (n=11) in the Gua Sha group presented a sha deficiency over the treatment area. Sha deficiency is characterized by blanching of the skin that is slow to fade after applying pressure.<sup>35, 36, 43, 44</sup> Given the number of subjects exhibiting sha deficiency, had the alternate method been used to bring about a sha blemish, perhaps a more dramatic increase in range of motion would have been identified.

### **Limitations**

A potential limitation of this study was that the Graston Technique® group was given ice and instructed to keep the ice on for twenty minutes; the examiner assumed that the subjects would follow instructions. While this may not have had an effect on the results, early

termination of icing may have influenced the amount of bruising subjects had after treatment. Subject adherence to directions does not pose any clinical implications as it is common practice for patients/athletes to be given an ice pack after treatment and sent home. Additionally as only the Graston Technique® group received ice, we cannot isolate any potential benefits that ice may or may not have had in relieving ITB tightness.

### **Future Research**

For the purposes of this study direct protocols were followed for each implement assisted soft tissue mobilization technique. The role of a dynamic warm-up, such as stationary bicycling is unknown. Future researchers should test each group with a standard warm-up to evaluate the role a warm-up has for each soft tissue mobilization treatment technique. While results of this study indicated that both implemented assisted soft tissue mobilization techniques improved range of motion, each employs very different protocols. Future research might examine the use of the Gua Sha tool and strokes in lieu of the stainless steel Graston Technique® tools to evaluate the significance of the specific Graston Technique® tools and strokes outlined within the given protocol. An additional control group that received only the stretching and strengthening exercises of the Graston Technique® protocol should be employed to further examine the holistic nature of the Graston Technique® protocol.

For the purposes of research and uniformity in this study the Gua Sha application of a set number of strokes along a stroke line over the treatment area was used. Researchers should compare the method used in this study, set number of strokes, and the method wherein a clinician administers strokes along a stroke line until a sha blemish occurs, in order to establish an evidence based protocol for Gua Sha.

### **Conclusions**

Clinicians who opt to use methods of soft tissue mobilization in relieving tightness can use implement assisted STM techniques to ease the stress on their hands that can often accompany manual STM techniques. Graston Technique<sup>®</sup> and Gua Sha are two methods of implement assisted STM and results of this study indicate that both are effective in increasing hip adduction range of motion. The Graston Technique<sup>®</sup>, however, demonstrated the greatest improvement in range of motion following the treatment protocol.

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**Table 1: Demographic means and standard deviations and baseline range of motion for each treatment group (n = 60)**

	Age (years)	Gender		Height (cm)	Weight (kg)	Baseline ROM (°)
Graston (n = 20)	20.7 ± 2.2	9 male	11 female	172.3 ± 9.3	70.3 ± 11.2	20.2 ± 4.4
Gua Sha (n = 20)	21.0 ± 2.6	16 male	4 female	176.8 ± 7.8	78.9 ± 12.8	20.0 ± 4.0
Control (n = 20)	20.3 ± 2.4	12 male	8 female	171.8 ± 10.6	73.0 ± 13.3	20.4 ± 3.3



**Table 2: Means, standard deviations for range of motion (°) for each treatment group on each test day**

	Graston	Gua Sha	Control
Baseline	20.2 ± 0.9	20.0 ± 0.9	20.4 ± 0.9
Day 1 Post-treatment	25.1 ± 1.1 *	21.7 ± 1.0	20.5 ± 1.0
Day 2 Post-treatment	25.5 ± 1.1 *	23.6 ± 1.1 †	21.9 ± 1.1
Day 3 Post-treatment	25.4 ± 1.2 *	23.6 ± 1.2 †	22.0 ± 1.2
Day 4 Post-treatment	27.0 ± 1.1 *	23.6 ± 1.1 †	22.4 ± 1.1

\* Significant difference from Graston baseline

† Significant difference from Gua Sha baseline

## LEGEND OF FIGURES

Figure 1- Acumar Digital Inclinometer used to measure degrees of hip adduction positioned on left thigh, midway between hip and knee

Figure 2- Stainless steel Graston Technique<sup>®</sup> tools used for treating ITB (GT-1, GT-3, GT-4) in Graston Technique<sup>®</sup> group

Figure 3- Gua Sha tool made of natural, polished horn used for treating ITB in Gua Sha group

Figure 4- Subject in modified Ober's testing position for measuring hip adduction. Subjects were positioned and secured on their right side with the hip and knee of the right leg bent to provide stabilization. Fastened straps were used over the subject's shoulder, back and hips to provide extra stabilization and to prevent excess hip movement during the test.

Figure 5- Flowchart outlining treatment procedures for each group for the testing period, including decision process for modifications.

Figure 6- Graston Technique<sup>®</sup>, Gua Sha and Control group hip adduction range of motion (degrees) as obtained from the modified Ober's test at baseline and post-treatment (post) on each test day.

Figure 7- Range of motion (degrees) for the Graston Technique<sup>®</sup> group at 3 times: pre Graston Technique<sup>®</sup> strokes, after the Graston Technique<sup>®</sup> strokes, and after the full Graston Technique<sup>®</sup> protocol

Figure 1- Acumar Digital Inclinometer used to measure degrees of hip adduction positioned on left thigh, midway between hip and knee



Figure 2- Stainless steel Graston Technique® tools used for treating ITB (GT-1, GT-3, GT-4) in Graston Technique® group



Figure 3- Gua Sha tool made of natural, polished horn used for treating ITB in Gua Sha group



Figure 4- Subject in modified Ober's testing position for measuring hip adduction. Subjects were positioned and secured on their right side with the hip and knee of the right leg bent to provide stabilization. Fastened straps were used over the subject's shoulder, back and hips to provide extra stabilization and to prevent excess hip movement during the test.

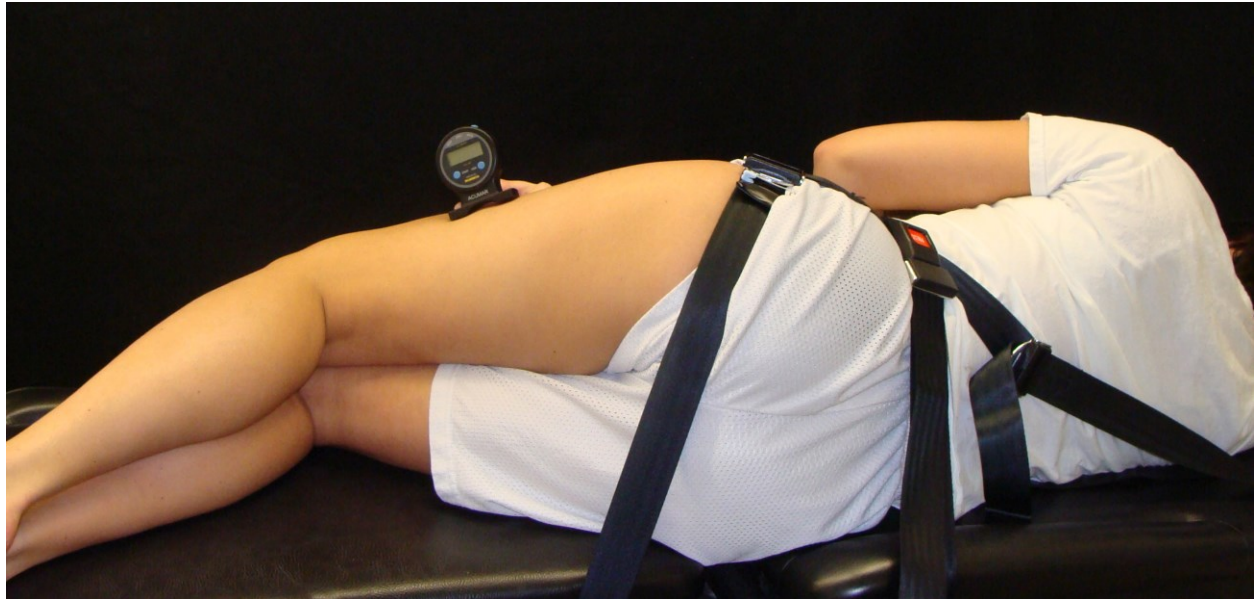


Figure 5- Flowchart outlining treatment procedures for each group for the testing period, including decision process for modifications.

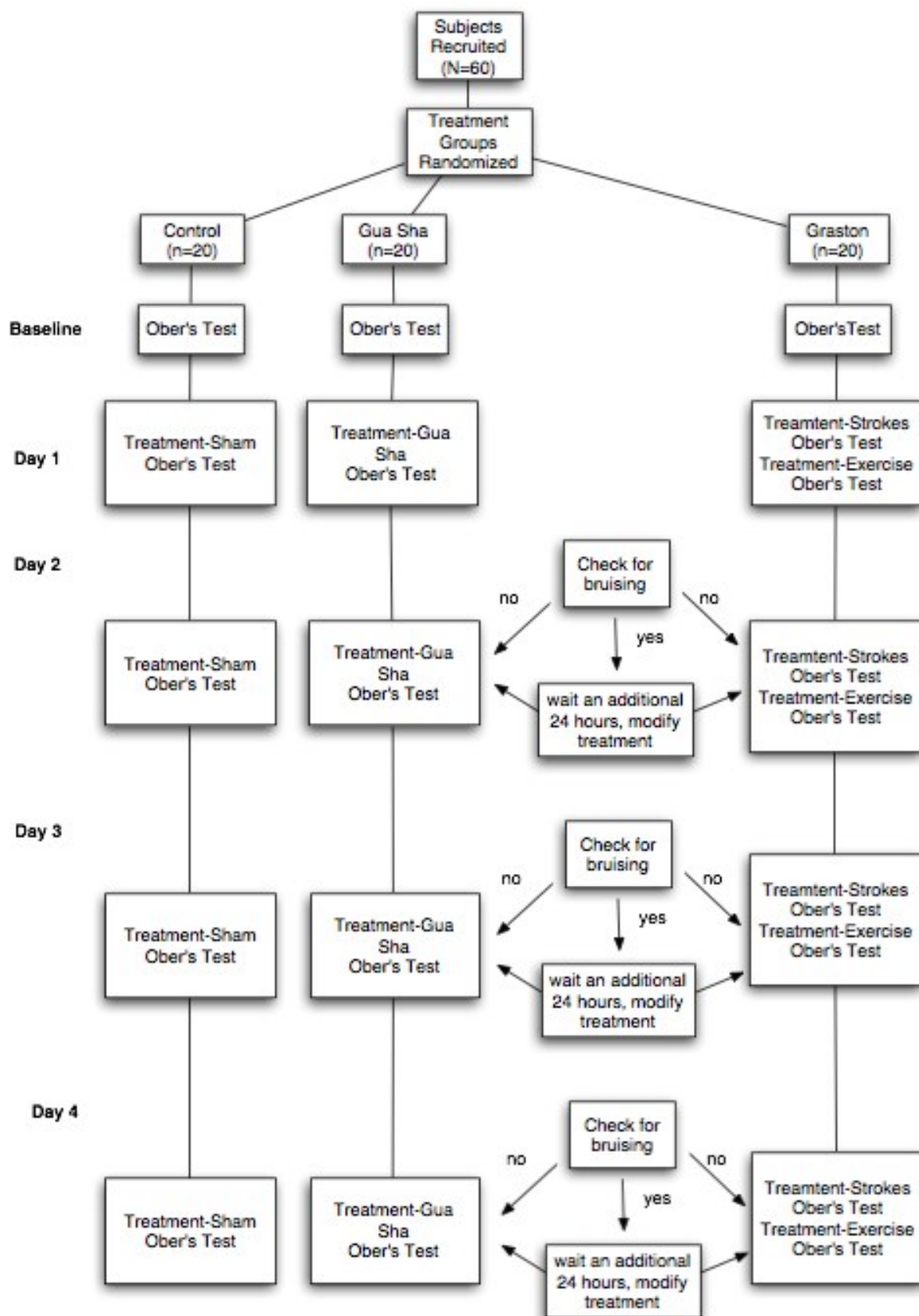


Figure 6- Graston Technique<sup>®</sup>, Gua Sha and Control group hip adduction range of motion (degrees) as obtained from the modified Ober's test at baseline and post-treatment (post) on each test day. A priori alpha levels set at  $p < 0.05$ .

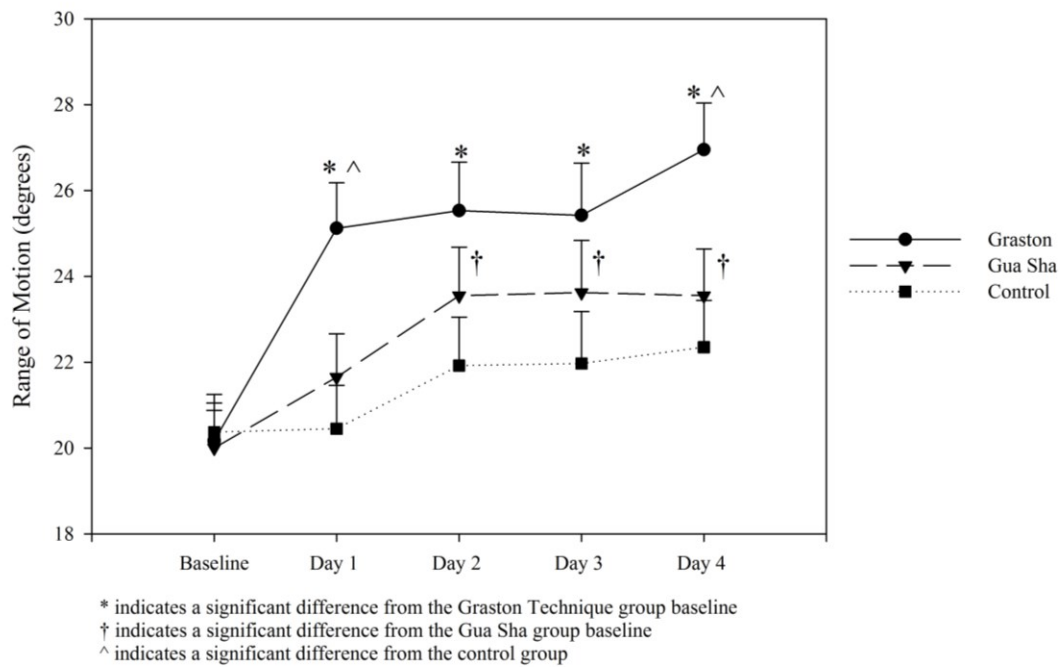
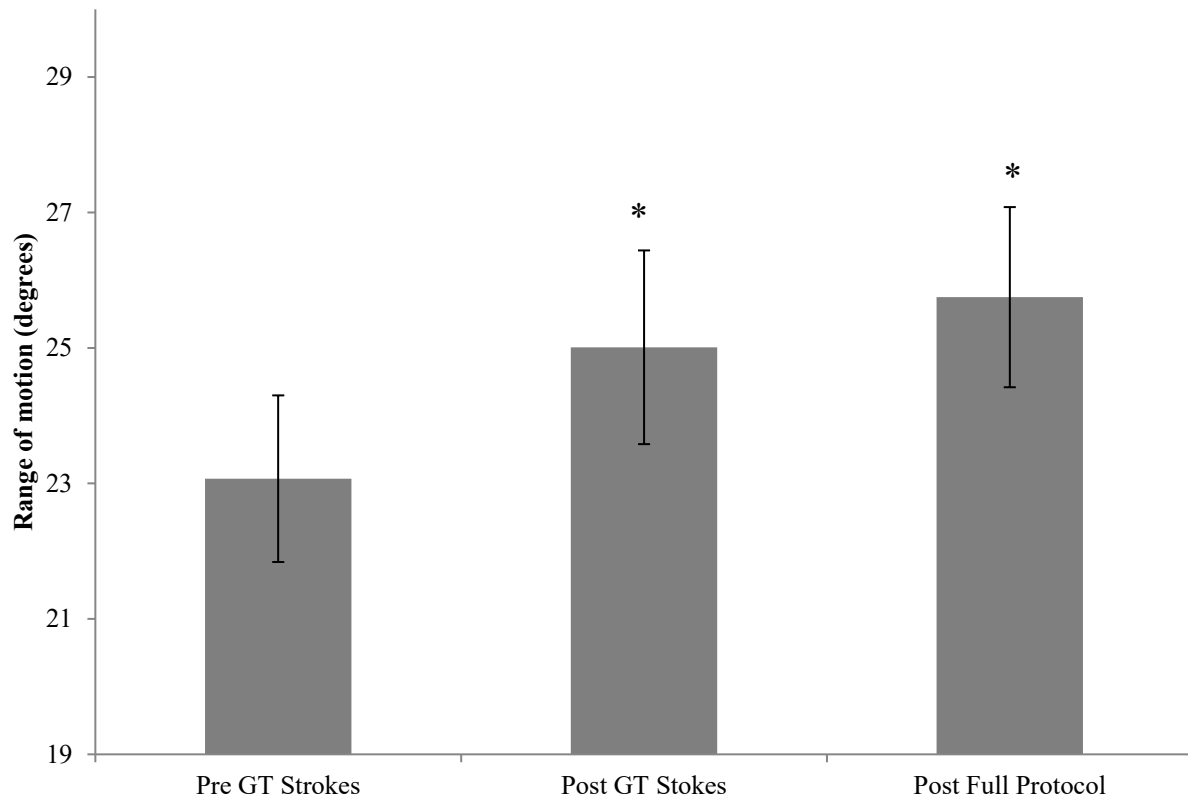




Figure 7- Range of motion (degrees) for the Graston Technique® group at 3 times: pre Graston Technique® strokes, after the Graston Technique® strokes, and after the full Graston Technique® protocol. \* represents a significant difference from the pre Graston Technique® strokes hip adduction range of motion measures. ( $p < 0.05$ )



## APENDICES

## **APPENDIX A**

Operational definitions

Assumptions

Delimitations

Limitations

Statement of the Problem

Independent Variables

Dependent Variables

Research Hypothesis

## **Operational Definitions**

Acceptable modified Ober's test: Test being performed without pelvic tilt.

Graston Technique®: Each Graston Technique® session will be approximately 8 minutes in length. To reduce friction and allow for glide of the instruments, emollient will be applied to the treatment area by clinician's hands. A five-minute active tissue warm up (stationary bicycle), will be followed by treatment using the GT-1 (handlebar), GT-3 (tongue depressor), and GT-4 (scanner) instruments over the ITB. Scanning, sweeping, fanning, brushing, strumming and framing strokes will be used with the instruments to treat the ITB. Specific stretches and strengthening exercises for the lower leg will then be done. Conclusion of treatment will be a 20 minute ice bag over the treatment area.

Gua Sha: Each Gua Sha session will consist of unilateral, downward stroking of the skin with the tool. Stroke lines will be marked off in 6 inch increments over the IT band. To reduce friction and allow for glide of the tool, emollient will be applied to the treatment area by clinician's hands. Each stroke line will receive 30 strokes with the tool. Time will be marked for total treatment time.

Hip Adduction: Hip adduction is the movement of the thigh towards the midline of the body.

Iliotibial Band Treatment Area: Treatment of the ITB will be from the lateral condyle of the tibia to the greater trochanter of the femur.

Iliotibial Band Length: Noted as degrees of hip adduction. A measurement of zero represents the leg in the horizontal position.

Inclinometer: An inclinometer measures degrees of range of motion. The Acumar Digital Inclinometer and Acumar IR Wireless Computer Interface (Lafayette Instrument Company, Lafayette, Indiana) will be used.

Modified Ober's Test: Subject lies on table on non-test side, knee and hip bent at forty-five degrees of flexion to provide stabilization and reduce lumbar curve. Examiner stands with proximal hand stabilizing pelvis at the anterior superior iliac spine (ASIS) of the test-leg and distal hand supporting the lower leg of the test-leg. Test leg is extended and the hip and leg are abducted. The examiner then allows the thigh to passively adduct until reaching end range of motion or pelvic tilt is felt or seen.

Physically Active: Engaging in aerobic exercise of any intensity for at least thirty minutes, a minimum of three times per week.

### **Assumptions**

The following assumptions will apply to this study:

1. Subjects will be truthful in answering a medical history form.
2. Subjects will be relaxed during the testing.
3. Time of day will not affect the measure of iliotibial band length.
4. Subjects represent a normal physically active college age population.
5. Subjects will be compliant to investigator's instructions.
6. Subjects will answer the post-treatment questionnaire honestly.

### **Delimitations**

The following delimitations will apply to this study:

1. All participants will be recruited from a large Midwestern university.
2. All participants will be between the ages of eighteen (18) and thirty (30).

3. Only the inclinometer will be used to measure hip adduction.
4. Subjects will have no recent history (past six months) of iliotibial band pain, patellofemoral pain syndrome, or iliotibial band syndrome.
5. Only Graston Technique® and Gua Sha methods of soft tissue mobilization will be used.
6. Only modified Ober's test will be used to measure hip adduction.
7. Only subjects with baseline measurements of 26 degrees or less of hip adduction will be included.

### **Limitations**

The following limitations will apply to this study:

1. Ability of examiner to give an identical treatment every time.
2. Only the Graston Technique® group receives ice.
3. Identical stabilization strapping during each iliotibial band testing.
4. All participants having similar outcomes to the treatment.

### **Statement of the Problem**

Soft tissue mobilization (STM) is a categorical term referencing various techniques of manual and implemented STM. Manual STM includes techniques of massage therapy, active release technique (ART®), muscle energy techniques, and myofascial release. Implement assisted STM techniques include any STM with the assistance of a tool, i.e. Graston Technique®, traditional Eastern medicine practice of Gua Sha. Practitioners currently use both implement assisted and manual forms of STM in clinical practice; yet no ideal method of STM has been established through evidence-based research. The purpose of this investigation is: 1) to determine if implement assisted soft tissue mobilization techniques influence iliotibial band

flexibility, and 2) to determine if differences exist between methods of implement assisted soft tissue mobilization, specifically Graston Technique® and Gua Sha technique.

### **Independent Variables**

Two independent variables will be evaluated in this study:

1. Treatment at three levels
  - a. Graston Technique®
  - b. Gua Sha
  - c. Control (sham microcurrent treatment)
2. Time at five levels
  - a. Baseline- pre treatment
  - b. Day one-post treatment
  - c. Day two- post treatment
  - d. Day three- post treatment
  - e. Day four- post treatment

### **Dependent Variables**

One dependent variable will be evaluated in this study:

1. Degrees of hip adduction with modified Ober's test

### **Research Hypothesis**

1. Graston Technique® treatment will cause a change in the amount of hip adduction.
2. Gua Sha treatment will cause a change in the amount of hip adduction.
3. A difference will exist between Graston Technique® treatment and Gua Sha treatment in the amount of change in hip adduction.

### **Null Hypothesis**

1.  $H_A: \mu_C = \mu_{GT} = \mu_{GS}$

### **Alternate Hypothesis**

1.  $H_A: \mu_C < \mu_{GT}$

2.  $H_A: \mu_C < \mu_{GS}$

3.  $H_A: \mu_{GT} \neq \mu_{GS}$



## **APPENDIX B**

### **Review of Literature**

## Review of Literature

Tightness of muscles, tendons, and supporting fascia is thought to limit range of motion of a joint, generate pain, and predispose an individual to related pathologies.<sup>1-5</sup> A common site of tightness in the lower extremity of physically active individuals is the iliotibial band (ITB).<sup>4</sup> Knee pathologies have been attributed to ITB tightness; including patellofemoral pain syndrome and ITB friction syndrome. Manual therapy, such as soft tissue mobilization is a common course of treatment for musculoskeletal tightness.<sup>1,3-8</sup> This review of literature will provide (a) a review of fascia, ITB anatomy, ITB etiology and pathologies; (b) examine assessment and quantification techniques of ITB tightness and (c) explore the soft tissue mobilization therapies, specifically Graston Technique® and the Eastern practice of Gua Sha.

### **Fascia and Fascial Tightness**

Fascia is a connective tissue sheath that surrounds all parts of the body.<sup>9</sup> The superficial layer of fascia immediately beneath the skin<sup>1,9</sup> provides a connection to the deep or aponeurotic fascia. The superficial fascia allows movement between the skin and underlying structures. Superficial fascia also provides protection, contains fat, nerves and vessels, and assists with heat insulation.<sup>1,9</sup> The deep fascia consists of dense connective tissue, which is composed of densely packed collagen fibers.<sup>1,5,9</sup> Deep fascia serves to separate muscles as a septa and provide structural support. The surface tension of fascia combined with the attachment to muscles, allows fascia to assist muscles' actions.<sup>9</sup> The International Fascia Research Congress regards fascia to be all dense fibrous connective tissue, including: aponeuroses, ligaments, tendons, retinacula, joint capsules, organ and vessel tunics, epineuria, the meninges, the periosteum, and all the endomysial and intermuscular fibers of the myofasciae.<sup>10</sup>

A unique characteristic of fascia is its ability to respond to micro-failure. Micro-failure is the breakage of individual collagen fibers and bundles when placed under tension.<sup>1, 5, 11</sup> The dominant cells of the deep fascia (fibroblasts) contain actin stress fibers, which respond to mechanical load.<sup>1</sup> Progressive, permanent, plastic deformation occurs as a result of micro-failure.<sup>1, 5, 11</sup> The broken fibers then enter a cycle of inflammation, repair, and reconstruction, which ultimately leads to the elongation of the connective tissue.<sup>1, 5, 11-13</sup>

Although fascia is throughout the entire body, fascia is often separated and discussed in relationship to the anatomical location of the fascia. Regional classifications include clavipectoral, axillary, brachial, antebrachial, thoracolumbar, plantar, palmar, crural, gluteal, fascia lata and the iliotibial tract.<sup>1</sup> The focus of this literature review will be on the fascia lata and the iliotibial tract.

### **Anatomy of the Iliotibial Band**

The iliotibial band (ITB) is considered to be a simple thickening of fascia, although cadaveric and MRI studies have revealed the structure's complexity.<sup>9, 14, 15</sup> In basic terms, the ITB originates on the area of the greater trochanter off the gluteus maximus, gluteus minimus, and tensor fasciae latae musculature and inserts distally on the tibial tuberosity.<sup>9, 14, 15</sup>

The fascia of the thigh has a superficial and deep layer, both encompassing the entire thigh.<sup>9, 16</sup> The fascia latae, a portion of the deep fascial layer, varies in thickness over the thigh. The fascia latae thickens distally into the iliotibial band. Authors have further investigated the layers of the ITB, revealing distinct and separate layers, each with their own separate fiber orientations, insertions and functions.<sup>2, 14-17</sup> Terry and colleagues<sup>15, 18</sup> dissected the iliotibial band into five layers: aponeurotic, superficial, middle, deep, and capsulo-osseous layers. The aponeurotic layer of the ITB includes the fascia covering the vastus lateralis and biceps femoris

and is the most superficial. The aponeurotic layer crosses the anterior aspect of the patella and patellar tendon, connecting medially with the sartorius. The superficial layer includes the vastus lateralis, iliopatellar band, lateral patellotibial ligament, iliotibial tract and the biceps femoris. The middle layer is tight to the superficial layer and has a different fiber orientation than the superficial layer, providing strength to both layers.<sup>15, 18</sup> The deep layer has an elevated curved orientation, from the supracondylar area of the femur distally towards the tibia and fibula. The deepest layer, the capsulo-osseous layer, is often referred to as the anterolateral ligament of the knee. The capsulo-osseous layer is continuous with the fascia of the plantaris and lateral head of the gastrocnemius and has a tibial insertion just posterior to Gerdy's tubercle on the tibia.<sup>2, 15, 17, 18</sup> This variation in thickness and fibers distinguishes the ITB into a proximal tendinous structure and a distal ligamentous structure.<sup>14</sup>

While the knee is in extension the ITB lies anterior to the lateral femoral condyle and moves posteriorly over the lateral epicondylar prominence as the knee moves through flexion.<sup>17</sup> Authors have suggested that the ITB is firmly attached to the distal aspect of the femur and is unlikely to roll in an anterior-posterior manner.<sup>14, 16, 19</sup> Fairlcough<sup>14</sup> suggests that the ITB may create an illusion of rolling due to the change and shift of tensile loads within the ITB during movement of the tensor fasciae latae. Authors<sup>2-4, 16, 19-22</sup> acknowledge the potential for ITB movement at the distal attachment to contribute to ITB pathologies, such as iliotibial band friction syndrome.

### **IT Band Tightness Pathologies**

Iliotibial band pathologies such as iliotibial band friction syndrome (ITBS) and patellofemoral pain syndrome (PFPS) are common in lower extremity athletes, particularly distance runners and cyclists.<sup>2, 4, 19-21, 23-25</sup> The increased force on the ITB causes biomechanical

changes, in turn producing pain at the insertions of the ITB.<sup>25</sup> ITBS is an inflammatory syndrome developed from the constant rubbing of the ITB tendon over the lateral femoral epicondyle.<sup>25, 26</sup> PFPS is the general classification of anterior knee pain due to overuse, malalignment, and/or muscular imbalances.<sup>21, 22</sup> ITB tightness has been considered a predisposing factor to ITBS and ITBS a precursor to PFPS.<sup>2, 4, 21</sup>

A clinical study of subjects presenting with PFPS found that 70% of subjects exhibited ITB tightness as indicated by a positive Ober's test and medial patellar glide test.<sup>21</sup> Overall 88% of subjects had a direct correlation between ITB flexibility and medial patellar glide.<sup>21</sup> Ballet dancers are a group prone to suffer from lower extremity overuse injuries.<sup>22, 26</sup> While ballet dancers are generally flexible they have noticeably limited hip adduction compared to the general population.<sup>22, 26</sup> A clinical study evaluating ITB tightness in ballet dancers found that 78% of ballet dancers complaining of PFPS had a tight ITB. About two-thirds (71%) of ballet dancers who were pain free, without PFPS, had normal ITB flexibility.<sup>22</sup>

### **Assessment and Quantification of Iliotibial Band Tightness**

Ober originally developed a diagnostic sign of ITB tightness, now referred to as the Ober's test.<sup>27</sup> The patient is side-lying, on the non-testing side with their knees flexed to 90 degrees. The examiner abducts and extends the hip so that the patient's leg is aligned with their trunk before allowing gravity to adduct the thigh as far as possible. Ober described a negative sign as the thigh adducting beyond the median line.<sup>27</sup> Kendall adapted a modified version of the Ober test; keeping the knee extended during hip extension and adduction.<sup>28</sup> Melchione and Sullivan<sup>7</sup> state no evidence exists to support the functionality of the ITB position as described in the original Ober test (90 degrees of knee flexion). A modified Ober's testing position has been utilized within the research with the knee minimally flexed (at 5 degrees of flexion).<sup>7, 29-32</sup>

Recent research has noted a significant difference in flexibility measurements between the Ober test and the modified Ober's test.<sup>29, 30, 32</sup> These findings suggest that the modified Ober's test and the original Ober's test should not be used interchangeably.<sup>32</sup>

Historically the Ober's test and modified Ober's test have been classified using observation<sup>2, 4, 22, 27, 33</sup> or goniometric measurements.<sup>29</sup> Melchione and Sullivan<sup>7</sup> first developed a method of measuring ITB length with a fluid filled inclinometer. Intratester and intertester reliability values of 0.94 and 0.73 were reported, respectively.<sup>7</sup> Reese and Bandy<sup>32</sup> expanded on previous work with a larger sample size, testing both Ober's test and the modified Ober's test. Intratester reliability of 0.90 and 0.91 were found for the Ober test and modified Ober test, respectively.<sup>32</sup> Current research uses the inclinometer with the combination of observation for measuring iliotibial band tightness flexibility.<sup>7, 23, 30-32, 34</sup>

Authors examining ITB tightness have recorded degrees of hip adduction during the Ober's and modified Ober's tests. Herrington<sup>30</sup> examined ITB tightness using the modified Ober's test, measuring hip adduction with an inclinometer. With the leg horizontal, equaling zero, mean hip adduction was  $16.2 \pm 5.4$  degrees.<sup>30</sup> Hudson<sup>23</sup> also examined ITB tightness with the modified Ober's test and an inclinometer, but in subjects suffering from PFPS. The control group measured  $21.4 \pm 4.9$  degrees and  $20.3 \pm 3.8$  degrees of hip adduction for the left and right legs, respectively.<sup>23</sup> Those suffering from PFPS had hip adduction measures of  $17.3 \pm 6.1$  in the symptom free leg and  $14.9 \pm 4.2$  in the PFPS symptomatic leg.<sup>23</sup> Reese and Bandy<sup>32</sup> reported hip adduction measures of  $23.2 \pm 6.9$  using the modified Ober's test. Recently Ferber using the Ober's test and a digital inclinometer found mean IT Band flexibility measurements of  $24.59 \pm 7.27$ .<sup>34</sup>

Research has shown a progression in hip adduction measurements from observation to quantitative measurement.<sup>2, 4, 7, 19, 22, 23, 27, 28, 30, 32, 33</sup> The Ober test and modified Ober test have been established as the “gold standard” for testing hip adduction and ITB tightness.<sup>2, 4, 7, 19, 22, 23, 27, 28, 30, 32, 33</sup> Recent studies have shown that healthy individuals, as well as those suffering from various pathologies, have direct hip adduction measurements with ranges of 10-30 degrees hip adduction,<sup>23, 30</sup> dependent on hip tilt and clearance from the opposite leg.

### **Soft Tissue Mobilization**

Manual therapy is a complementary therapeutic intervention that utilizes techniques performed by clinician’s hands to treat, evaluate and manipulate soft tissues.<sup>35</sup> Allied health care professionals use a variety of soft tissue mobilization therapies to relieve pain, decrease tightness, relieve adhesions, and reduce loss of function in soft tissues.<sup>35</sup> Implemented soft tissue mobilization techniques have been developed in recent years as manual therapy has increased in popularity in order to preserve clinician’s hands and bodies.<sup>36, 37</sup> Various forms of implemented soft tissue mobilization are used in the clinical setting; this review will specifically examine the Graston Technique® and the Eastern medicine practice of Gua Sha.

### **Graston Technique®**

Graston Technique® is a soft tissue mobilization technique utilizing stainless steel instruments to treat various soft tissue adhesions and injuries. Graston Technique® is also referred to as Graston Instrument Assisted Soft Tissue Mobilization (GIASTM or GISTM) or simply Instrument Assisted Soft Tissue Mobilization (IASTM). Graston Technique® was originally developed by a semi-professional athlete who suffered a knee injury while water skiing who designed a tool to provide relief of his own injuries, after surgery and traditional therapies failed to help his injury.<sup>36</sup>

Graston Technique<sup>®</sup> uses specially designed stainless steel instruments to detect and treat all forms of soft tissue pathologies. The stainless steel instruments allow vibrations to be transmitted through the instruments unlike plastic or aluminum instruments that absorb vibrations.<sup>36, 37</sup> Each instrument is designed to provide ergonomic comfort to the clinician and provide the clinician with a mechanical advantage during treatments. The set of six instruments are each designed with a surface area of the body considered.<sup>36, 37</sup> Tools are designed with a concave and convex surface, as well as a single or double beveled edge design. This design provides optimal contact with the body surface being treated and allows for pressure applied by the clinician to be equalized throughout the tool.<sup>36, 37</sup>

The clinician utilizes seven different strokes with the instruments to either assess or treat restrictions, both locally and generally.<sup>36</sup> Assessment or scanning strokes include sweeping and fanning. Treatment strokes include brushing, strumming, J-stroke, swivel, and scooping. The clinician can choose to use the instruments with a double or single handhold; depending on individual comfort level. Sweeping strokes are light pressured strokes used to assess the area in a linear or curvilinear path parallel to the fibers being treated. Fanning strokes are another assessment stroke in which the instrument is stabilized at one end as a fulcrum while the opposite end moves. Brushing is a treatment stroke that is also a preparatory stroke for strumming. Brushing is light, higher rate stroke done in small linear movements in a multi-directional manner. Strumming is a deep, linear stroke that is done perpendicular to the fibers being treated, one direction at a time. The J-stroke follows a J-shaped pattern and can be either a superficial or deep stroke. The swivel stroke allows the clinician to provide an oscillation to a focal area, the treatment edge remains stationary while the clinician swivels the instrument. Scooping strokes treat deep restrictions by working to lift adhesions from multiple directions. Framing is a



technique applied around a boney structure or specific point; the strokes work towards and away from the area. All strokes are given with the instruments at a 30-60 degree angle to cause an appropriate degree of tissue excitation.<sup>36</sup>

A typical Graston Technique® treatment protocol consists of five components: warm-up, Graston Technique®, stretches, specific exercises and cyrotherapy.<sup>36, 37</sup> The warm-up phase is intended to increase blood flow and provide tissue heating. The application of the Graston Technique® strokes breaks up soft tissue restrictions. High repetition, low weight exercises then aid in the fatigue of shortened structures and change fascial compartment dimensions. A period of stretching is then performed to lengthen shortened structures, and low repetition high weight exercises are performed to strengthen weak or lengthened structures as treatment progresses. Cryotherapy is used to minimize post-treatment inflammation, soreness, and bruising that sometimes occurs as a result of Graston Technique®.<sup>36, 37</sup>

Theoretically Graston Technique® stimulates the inflammatory process, allowing for the healing cascade of inflammation, repair and remodeling, to begin.<sup>12, 13, 38</sup> The inflammatory or immune response is the initial reaction after an injury, lasting 2-3 days.<sup>12, 13</sup> During this acute inflammatory period there is an immediate vascular response, histamine reaction, release of cellular mediators and clot formation.<sup>12, 13, 38</sup> The inflammatory process prepares the tissues for the second phase of the healing cascade, the fibroblastic repair phase. Starting on days 3-4 and lasting up to 4-6 weeks the fibroblastic repair phase is proliferative, regenerative cellular activity leads to a period of fibroplasia and repair of tissue.<sup>12, 13, 38</sup> Fibroplasia is the period of repair that is achieved from the laying down of collagen fibers by the fibroblasts, which is started by day 6-7 after injury. Healing is initiated through the recruitment and activation of fibroblasts and fibroblastic proliferation.<sup>12, 13, 38</sup> The final state of the healing cascade, remodeling or maturation,

is signaled by the decrease in the number of fibroblasts and the realignment of collagen fibers and increase in strength of the tissue matrix.<sup>12, 13, 38</sup> This final phase is an ongoing process that lasts from 4 weeks post injury up to several years.

Studies on rat Achilles tendons have shown that Graston Technique® facilitates healing, especially in the early stages.<sup>39-41</sup> Collagen fibers are highly elastic during the fibroblastic stage; Graston Technique® treatment during this time creates significant changes in the tissues.<sup>39-41</sup> One such study examined the morphological and functional changes in rat Achilles tendons following an induced injury.<sup>39</sup> Rats were given an injection of collagenase to produce tendonitis in the Achilles tendon.<sup>39</sup> Microscopic examinations revealed that those rats receiving Graston Technique® had increased tissue healing and an increased fibroblast count after injury.<sup>39</sup> Functional screening revealed that rats who sustained an injury and were treated with Graston Technique® had positive changes in gait.<sup>39</sup> Another rat study examined the variation of pressure during soft tissue mobilization treatments.<sup>40</sup> Again Achilles tendonitis was created through the injection of collagenase and rats were divided into control and Graston Technique® treatment groups of light, medium or extreme pressures. Light microscopy evaluation of fibroblast production revealed that all groups receiving Graston Technique® had an increase number of fibroblasts, indicating an increase in healing.<sup>40</sup> Fibroblast count revealed that those in the extreme pressure group had significantly more fibroblasts than the control group.<sup>40</sup> While healing was found in all rats who received Graston Technique®, a direct relationship between the amount of pressure given during treatment and the increase in healing existed.<sup>40</sup>

A recent study examined knee ligament healing time in rats.<sup>41</sup> Rats were surgically given a medial collateral ligament (MCL) injury and divided into control, injured, and injured with Graston Technique® intervention groups. Mechanical and light microscopy results revealed that

MCL injuries treated with Graston Technique® were stronger, stiffer and had better shock absorption than injured ligaments receiving no treatment.<sup>41</sup> Rats in the Graston Technique® group also had improved fiber bundle formations and orientations than those without the Graston Technique® treatment.<sup>41</sup> Rat studies have shown Graston Technique® to create functional changes in tendons and fascia,<sup>39-41</sup> although limited human studies have been published that examine the role of Graston Technique® on human tissue change.

Through several case studies, the literature has shown Graston Technique® to be beneficial in treating soft tissue pathologies.<sup>37, 39-51</sup> Graston Technique® has been shown effective in treating tendonitis conditions including: carpal tunnel syndrome,<sup>43, 44</sup> lateral epicondylitis,<sup>46</sup> Achilles tendonitis<sup>47</sup> and plantar fasciitis.<sup>47</sup> One case study<sup>43</sup> discussed a forty-two year old woman suffering from bilateral carpal tunnel syndrome. After only six weeks (12 sessions) of Graston Technique® complete pain relief and return to normal activity, teaching piano lessons, was achieved.<sup>43</sup>

Graston Technique® has also been used to relieve soft tissue pathologies which cause pain such as ankle fibrosis,<sup>51</sup> trigger finger,<sup>37</sup> shoulder pain,<sup>47</sup> chest pain and thoracic stiffness,<sup>42</sup> and lumbar compartment syndrome.<sup>48</sup> In one case, a fifty-three year old male with trigger finger, exhibiting catching with flexion/extension and painful spasm with forceful grip had a 50% improvement in symptoms after his first Graston Technique® treatment.<sup>37</sup> After seven treatments over a period of four weeks the patient had a 95% relief in total symptoms.<sup>37</sup> A case study of a fifty-nine year old man diagnosed with lumbar compartment syndrome was asymptomatic after six sessions of Graston Technique®.<sup>48</sup> Flexibility was improved over the course of treatment; functional rotation, external rotation, and hamstrings all had significant increases in range of motion.<sup>48</sup>

One case study<sup>51</sup> presented a twenty-year-old male football player with a history of ankle injury and surgery was treated with Graston Technique® for loss of function, decreased range of motion, dysfunctional scar tissue and immature post-surgical dermal scar on his ankle. He was treated for seven weeks, receiving Graston Technique® protocol twice a week.<sup>51</sup> At the end of seven weeks the athlete's pain had ceased with activity, and range of motion had increased. MRI images revealed that excessive dysfunctional scar tissue had softened and diminished and the surgical scar had matured.<sup>51</sup>

### **Gua Sha**

Gua Sha is a traditional Eastern medicine and cultural practice for the treatment of various ailments.<sup>52-54</sup> Gua in Chinese is translated as to scrape or scratch. In reference to Gua Sha, Gua consists of pressured stroking with a smooth edged tool in repeated strokes until a sha blemish appears.<sup>52-54</sup> Sha is translated literally as sand, sharkskin, or red, raised, millet-sized rash. Sha is also translated as cholera and used to describe the presence of blood stasis. In reference to Gua Sha, sha is the petechia that appears following treatment.<sup>52-54</sup> Gua Sha is synonymous to the Vietnamese practice of Cao Goi; and is commonly translated as coining, scraping, and spooning.

Traditional Gua Sha tools include the Chinese soup spoon, a coin, a metal cap with a smooth round lip, or a slice of horn, bone or jade. In the clinical setting the later are more commonly used and several manufactures in the United States produce Gua Sha tools.<sup>52-54</sup>

Gua Sha treatments start with the lubrication of the area to be treated with plain oil or balm.<sup>54</sup> The Gua Sha tool is then applied to the skin with enough pressure to contact the fascial layer but not to cause pain.<sup>52, 54</sup> Stroking along a stroke line (four to six inches) is performed until the sha blemish appears (usually eight to twelve strokes). Stroking stops when sha has

appeared as petechiae, but before ecchymosis occurs.<sup>52, 54</sup> One stroke line is completed at a time until all adjacent stroke lines of the treatment area have been addressed. A receiver of Gua Sha should not experience pain from the treatment, only pressure from the stroking of the tool along the fascia. Petechia immediately fades, potentially to ecchymosis, and typically skin is returned to normal within two to four days.<sup>52, 54</sup>

While numerous Chinese medical studies exist, studies published in English examining the physiologic effects of Gua Sha are limited.<sup>53, 55</sup> Lee and colleagues<sup>56</sup> found a total of seven studies that examined Gua Sha therapy, five randomized control trials and two controlled clinical trials. All seven trials found that Gua Sha was effective in pain management, and there were no adverse effects found in any of the studies.<sup>56</sup> A recent study examining Gua Sha as a treatment for neck pain found Gua Sha more beneficial in relieving pain than control treatments of a hot pack.<sup>57</sup> A study by Chiu et al<sup>58</sup> examined Gua Sha therapy and traditional therapy (heat and massage) for Taiwanese women experiencing breast engorgement. Results showed that the Gua Sha group took less time to treat and had statistically better breast engorgement relief scores than the control group.<sup>58</sup> Nielsen et al<sup>53</sup> examined the effect of Gua Sha on surface tissue microcirculation. Doppler laser imaging revealed increases in microcirculation and decreased myalgia was reported by subjects.<sup>53</sup> To date no Western based, English research has been conducted on the effects of Gua Sha on musculoskeletal tightness, although case reports have shown Gua Sha to be effective in increasing range of motion.<sup>54</sup>

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